CLAIMS:

1. A method of determining best process variables setting that provides optimum process window for a lithographic production process comprising transferring a mask pattern into a substrate layer, which process window is constituted by latitudes of controllable process parameters and which method comprises the steps of:

– acquiring a data set of a focus-exposure matrix for a feature of the mask pattern having critical dimension (CD), which feature has a predetermined design CD value being the CD value that should be approximated as close as possible when transferring the feature to the substrate layer, and

– checking whether transferred images of the feature meet design tolerance condition, and determining which combination of values of controllable process variables provides the CD value closest to the design value and the best process latitude, characterized in that the process of checking and determining the best combination comprises the steps of:

1) defining a statistical distribution of relevant process variables, the parameters of the distribution being determined by estimated or measured variations of the process variables;

2) fitting the coefficients (b_1- b_n) of an analytical model (CD(E, F)) that describes the CD value as a function of the process variables focus (F) and exposure dose (E);

3) calculating the average CD value and the variance of the CD distribution using the analytical model CD(E, F) of step 1);

4) determining quantitatively how the CD distribution fits to a desired process control parameter C_{pk}; and

5) determining the best process setting for the design feature by determining the exposure-dose value and the focus value which provide a maximum C_{pk} value.

2. A method as claimed in claim 1, wherein at least one other process variable is included, characterized in that a number of values for the another parameter are introduced, in that in step 1) the coefficients of the model are interpolated as a function oft the other parameter, in that between step 2) and step 3) an additional step is carried out comprising:

2a) determining for each possible E and F combination the value of the other variable that is needed to form a printed feature having the size of the design feature, thereby using the interpolated E and F values of step 2);

in that steps 3) and 4) are carried out for each value of the other process parameter, and in that in step 5) the exposure dose value, the focus value and the value of the other parameter which provide the maximum C_{pk} value are determined.

3. A method as claimed in claim 1 for optimizing focus and exposure-dose settings, characterized in that the analytical model used in step 1) uses the following relationship between the CD value and the focus and exposure-dose values (E; F):

$$CD(E,F) = b_1.(F^2/E) + b_2.F^2 + b_3.(F/E) + b_4.F + b_5.(1/E) + b_6$$

wherein $b_1 - b_6$ are the coefficients of the model.

4. A method as claimed in claim 3, for Gaussian focus and exposure dose distributions, characterized in that for the calculation in step 3) of the average CD value (μ_{CD}) and the variance of the CD distribution (σ_{CD}) the following equations are used:

$$\begin{aligned}\sigma_{CD}^2 = {} & \sigma_F^2\,(1/\mu_E^2).\ (B32 + 4\,b_{13}\mu_F + 4\,b_1^2\mu_F^2) + \\ & \sigma_F^2\,(1/\mu_E).\ (2b_{34} + 4\,(b_{23} + b_{14})\,\mu_F + 8\,b_{12}\mu_F^2) + \\ & \sigma_F^2.\ (b_4^2 + 4\,b_{24}\mu_F + 4\,b_2^2\mu_F^2) + \\ & \sigma_F^4\,(1/\mu_E^2).\ 2b_1^2 + \sigma_F^4\,(1/\mu_E).\ 4b_{12} + \sigma_F^4\ .\ 2b_2^2 + \\ & \sigma_E^2\,(1/\mu_E^4).\ (b_5^2 + 2\,b_{35}\,\mu_F + (b_3^2 + 2b_{15})\mu_F^2 + 2b_{13}\mu_F^3 + b_1^2\mu_F^4\,) + \\ & \sigma_E^2\,\sigma_F^2\,(1/\mu_E^4).\ (3b_3^2 + 2\,b_{15} + 14\,b_{13}\,\mu_F + 14b_1^2\mu_F^2) + \\ & \sigma_E^2\,\sigma_F^2\,(1/\mu_E^3)\ .\ (2b_{34} + 4(b_{23} + b_{14})\mu_F + 8b_{12}\mu_F^2) + \\ & \sigma_E^2\,\sigma_F^4\,(1/\mu_E^4).\ 7b_1^2 + \sigma_E^2\,\sigma_F^4\,(1/\mu_E^3).\ 4b_{12} + \\ & \sigma_E^4\,(1/\mu_E^6).\ (2b_5^2 + 4b_{35}\mu_F + (2b_3^2 + 4b_{15})\mu_F^2 + 4b_{13}\mu_F^3 + 2b_1^2\mu_F^4) + \\ & \sigma_E^4\,\sigma_F^2\,(1/\mu_E^6).\ (3b_3^2 + 4b_{15} + 16b_{13}\mu_F + 16b_1^2\mu_F^2) + \\ & \sigma_E^4\,\sigma_F^4\,(1/\mu_E^6).\ 8b_1^2\ .\end{aligned}$$

wherein b_1 –b_6 are the coefficients of the analytical model, μ_E and μ_F are the average values of the exposure dose and focus distributions, respectively, σ_E and σ_F are the standard deviations of these distributions, and b_{ij} stands for b_i x b_j.

5. A method as claimed in claim 2, characterized in that the another process variable is a mask bias.

6. A method as claimed in claim 1, 2, 3, 4 or 5 for a process for printing a mask pattern having different structures, characterized in that the C_{pk} of the structure having the smallest C_{pk} value at the predetermined focus and exposure dose is used to determine the overall process window for all structures in the mask pattern at that focus and exposure dose.

7. A method for setting optimum process window for use in a lithographic production process, which process comprises transferring a mask pattern in a substrate layer and which method comprises determining optimum process window and setting controllable process variables according to this window, characterized in that the optimum process window is determined by means of the method as claimed in any one of claims 1-6.

8. A lithographic process for manufacturing device features in at least one layer of a substrate, which process comprises transferring a mask pattern into the substrate layer by means of a projection apparatus thereby using an optimized process window defined by latitudes of controllable process parameters, characterized in that the process window is optimized by means of the method of claim 7.

9. A device manufactured by means of the lithographic process as claimed in claim 8.

10. A computer program product for use with the method of claim 1 and comprising programmable blocks for programming a programmable computer according to the processing steps of the method.

11. A lithographic mask having a mask pattern, which comprises pattern features having been optimized by means of the method of claim 1.